THE WESTERN AUSTRALIAN
NATURALIST

Vol. 15 January 31, 1984 No. 8

NOTES ON THE CRAB FAUNA OF MANGROVE BAY, NORTH WEST CAPE

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INTRODUCTION

One of the most interesting aspects of the Cape Range National Park at Northwest Cape is the unique freshwater fauna that inhabits the subterranean waters of the very porous limestone plain. The four known species of this fauna are all blind (Mees 1962), consisting of a gudgen (*Melyringa veritas*), an eel (*Anommatophasma candidum*) and two species of shrimp (*Stygiocaris lancifera* and *S. stylifera*).

The lens of freshwater is fed by direct rain or by runoff from Cape Range and the freshwater slowly filters through the porous limestone towards the coast. The importance of this groundwater intrusion on the well-being of the mangroves of Mangrove Bay has been discussed by Johannes (1982) who recorded low salinities of 22 parts per thousand (‰) near healthy mangroves at the southern end of the system but exceptionally high readings of 60 and 102‰ at the northern end where dead or stunted trees abound.

This study of the 13 species of crabs that live in and around the Mangrove Bay system was conducted in March 1982, and it could serve as a basis for future assessment of the effects of ground water changes on the mangroves and associated fauna, which could assist in management strategies of this important section of the Park.

DESCRIPTION OF THE AREA

Mangrove Bay lies to the north of Low Point and contains a small but well developed mangrove system (Fig. 1). It is protected from direct ocean swells by a fringing reef, known as the Ningaloo Reef, that extends from Coral Bay to North West Cape. The mouth of the main creek is bordered by the narrow sandy beaches of the bay. To the east the main creek divides into three minor creeks, and further eastward these minor creeks lead into an extensive north-south back lagoon.

The Mangrove Lagoon

This tidal lagoon - semidiurnal tides, with a range at +2.0m (MHWS) to +0.3m (MLWS) - is considered to be supplemented by a groundwater inflow and is roughly tear-drop shaped, with the broadest and deepest area (0.5-1.0m) in the south. The lagoon is moated and overfills on the high tide. About half of the southern lagoon is studded with numerous rocks, mostly submerged, but a few are elevated, and some have mangrove trees growing on them. Depressions in the lagoon floor are filled with fine silt and a filamentous green alga grows in these areas.

In the northern lagoon the floor tilts to the north and the areas of rock become less until they disappear under the fine sediment at the northern extremity. In the central part of the lagoonal system, where two minor creeks originate, shallow banks of fine silt have been deposited. At low tide the southern minor creek has water running out since it is apparently fed from the lagoon. The northern minor creek has a rock bar that becomes effective at low tide. Where the minor creeks (depth 1.5m) join to form the short main creek, the channel is shallower (0.5m). A combination of the ebb and flow of the tide and apparent inflow of groundwater is sufficient to prevent a sand bar forming across the mouth of the main creek (a fully barred situation occurs at several nearby 'creek lagoons' along the west coast of the peninsula).

The Mangroves

The lagoonal system and the minor creeks are edged with a band of mangrove trees which may reach a height of 5.0m. Only three species of mangrove occur in the area - the predominant species is *Avicennia marina* and some isolated

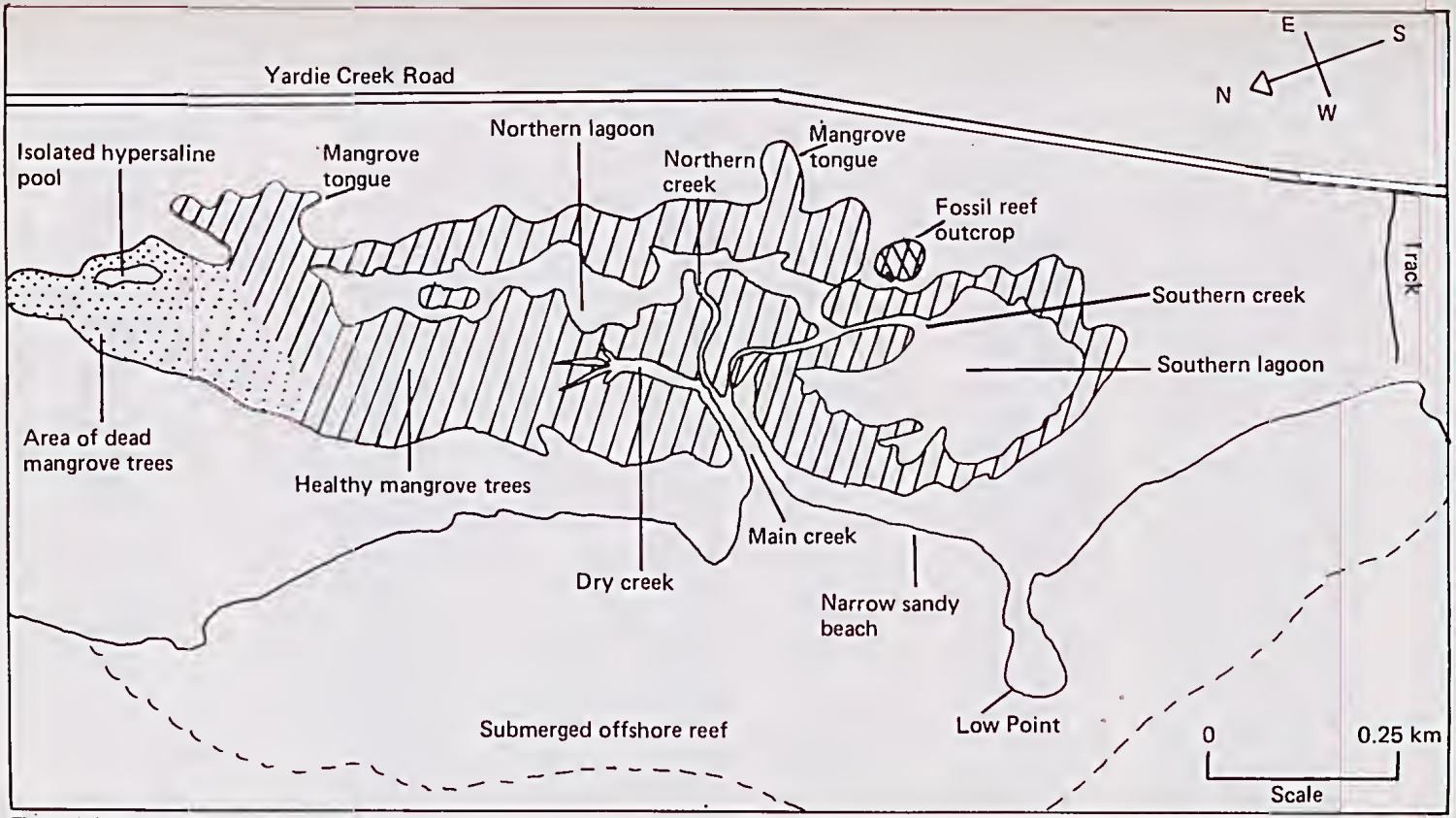

Figure 1. Mangrove Bay, North West Cape.

trees (about 10) and seedlings of *Rhizophora stylosa* also occur. Mr. R. Johnstone (pers. comm.) recorded one small *Bruguiera exaristata* tree and several seedlings in 1980. Landward of the mangrove system, drainage channels run in from Cape Range, and in these areas small tongues of mangroves indicate the influence that groundwater plays in the mangrove system. Several areas of fossil reefs occur as outcrops along the south-east side of the mangrove system. In the north-east the mangroves become markedly smaller (1.0-2.0m); some have died, and the proportion of dead trees progressively increases northward until, at the northern limit, all trees are dead. In this northern region a small isolated pool of hypersaline water (57‰) remains as a remnant of what was once a much larger lagoonal system; it is surrounded by a very narrow fringe of small (1.0-2.0 m) healthy mangrove trees. Towards the edges of the dead northern mangrove region, some debilitated trees had small areas of new shoots and green leaves on them and healthy mangrove seedlings (10-50cm) also occurred amongst these trees (March 1982). Along the western side of the northern lagoon is an extensive mangrove belt which progressively increases in size and in healthy growth southward, until fully grown, healthy trees occur again towards the main creek.

THE CRABS OF MANGROVE BAY

Thirteen species of crab were obtained from Mangrove Bay.

Hermit Crabs (*Coenobita spinosa*) live in the sand dunes above the beach slope. Apart from their larval stages, these animals spend their lives on land. *Coenobita spinosa* is a grey-buff colour and the left claw is slightly larger than the right. Land hermit crabs rarely walk further inland than a few hundred metres from the shore, moving about a great deal on warm nights. In the heat of the day, protection is sought under dead leaf litter or grass and in cold weather they burrow deep under dead vegetation and seem to hibernate.

Ghost Crabs (*Ocypode*). Two species were found on the sandy beaches of Mangrove Bay - *Ocypode convexa* and *O. ceratophthalma*. By torchlight at night, ghost crabs were observed running swiftly across the beach when disturbed. In daylight the openings to the burrows of these crabs can be observed above the strand line. *O. ceratophthalma* outnumbers *O. convexa* by about 10:1 along the bay to the south of Low Point and it has distinctive, corneous extensions beyond the eyes in adult specimens - hence its common name, the horn-eyed ghost crab. It is a swift running crab with white claws, a dark underside, and a brown 'H' on its back. *O. convexa* has golden yellow claws which give it the common name, the golden ghost crab. It is slightly larger than *O. ceratophthalma* but runs more slowly and has a faint light mark on its back. The burrows of *O. convexa* are usually higher up the beach than those of *O. ceratophthalma*. Sometimes on overcast, cloudy and rainy days, both species will emerge from their burrows to forage along the strand line.

Fiddler Crabs (*Uca*) are brightly coloured and the males are readily distinguishable by an enormously enlarged claw which is waved or 'fiddled' during courtship displays to females, or in aggressive combat with other males; the waving patterns are characteristic for each species. Females have two small, equal-sized claws and are more drab than the colourful males. Fiddler crabs are reasonably small (up to about 3.5cm wide) and emerge from their burrows in the daytime as the tide ebbs. At high tide their burrows are submerged. They may be readily observed feeding and moving near their burrows providing one stands very still for a few minutes. However, they have excellent vision and dart quickly into their burrows at the slightest movement.

Two species of fiddler crab were observed between Low Point and the main creek, where the beach sand meets the more muddy reef platform, and where the aerial roots (pneumatophores) of the mangrove trees protrude through the muddy sand. The yellow-clawed fiddler crab, *Uca mjobergi*, lives in the sandier habitat and extends along the southern sand banks of both the main creek and the southern minor creek. It is small (1.2cm carapace width) with a mottled grey/brown back and with its legs speckled or banded brown and white. Distributed slightly below *U. mjobergi*, on the muddy reef platform, Dampier's fiddler crab, *U. dampieri*, was observed at low tide. This is a moderate sized species (1.7cm c.w.) and the large claw of the male is orange-red on the lower portions and whitish on the upper areas. The back is black-brown with the anterior one-third whitish-blue.

Uca flammula, with a black back and a brilliant orange-red claw occurred on

the shoulder of the minor creeks. The legs are brilliant red, giving it the common name of Darwin Red Legs. *U. flammula* can grow to a carapace width of 3.5cm.

Along the muddy lower banks of the minor creeks, the small (2.4cm c.w.) pink-clawed fiddler crab, *U. polita*, was found. The large male claw is rose-pink with white fingers and the back is brown and blue-black with cream or white spots posteriorly.

The Elegant fiddler crab, *U. elegans*, was found in the mangrove lagoon in areas of fine silt, deposited where the two minor creeks originate. This crab has a carapace width of 2.6cm and is named in reference to the long and elegant fingers of the claws. The large claw of the male is orange-red to pink-grey with white fingers and the backs of males and females are brown-blue-green with brown speckling.

Marsh Crabs (*Sesarma*) are readily recognised by their broad fronts and square backs. They also have very distinctive, grating-like areas on each side of the mouth frame and these assist in the re-oxygenation of water held in the gill chambers when the crab comes out of its burrow onto dry land. Two species of *Sesarma* occurred along the banks of the minor creeks and on the landward mangrove edge and large numbers of their hooded burrows were evident amongst the *Avicennia* trees. Marsh crabs are difficult to observe in the day-time but sometimes towards evening or on dull, overcast days they can be seen standing in the protection of the hood of the burrow. Marsh crabs are quite large (4.0cm c.w.) and have brown-black backs; one species has orange claws and the other species has red claws.

Swimming Crabs (*Portunidae*) usually live in estuaries or in the sea and are so-named because the posterior pair of legs is flattened and expanded to form paddles; these are used for both swimming and for working their way under the sand for protection. In the pools and channels on the reef platform, three species of swimming crab are found.

The Mangrove or Mud Crab, *Scylla serrata*, is quite common and was found in muddy holes in eroded areas of the reef platform or swimming in more open areas in the creeks and in the lagoon. It is a very large crab and can reach a carapace width of 22.0cm and a weight of more than two kg. The body colour varies from green through greenish-brown to brownish-blue. The claws are very large and are powerful enough to crush large thick shells. Another swimming crab common on the reef platform, in the creeks and in the back lagoon is the Blue Snapping Crab, *Thalamita crenata*. This is a smaller (6.0cm c.w.) and less powerful crab than the Mangrove crab but when disturbed it is quick to adopt a menacing posture with its heavy claws. Less common is *Portunus pelagicus*, the Blue Swimming Crab. The body and legs are mottled brown, blue and white and it can reach 20cm carapace width. The back of this crab characteristically has a long sharp spine protruding from each side. This is the common commercial crab of the south-west estuaries of Western Australia.

THE CRABS AND THEIR HABITATS

Thirteen species of crabs (including one land hermit crab, which is not a "true" brachyuran crab) have been recorded at Mangrove Bay. Some species prefer the sand beaches which are reasonably well protected from the oceanic swells by the Ningaloo barrier reef, others occupy the beach on the sandy or muddy reef platform while others occur on the banks or the floor of the creeks. The floor and the central banks of the back lagoon provide yet another habitat due to the complete protection from wave or current movements. The mud along the landward margin of the mangrove belt provides a further distinct habitat for burrowing crabs. The species of crab living in these separate habitats are set out in Table 1.

Because of their position in the mangrove with respect to tide, substrate and groundwater characteristics, each species has different physiological requirements, particularly those related to respiration and dehydration. Table 2 sets out the major environmental influences operating on each species and their aquatic or terrestrial requirements for respiration. A reliable source of food for each species is important to its persistence and for the crabs of Mangrove Bay, this food source includes fallen leaves and fruit (Marsh Crabs), strand line flotsam (Ghost Crabs and Land Hermit Crabs), bacteria and microscopic plants (Fiddler Crabs) and living molluscs, other crustacea or worms (Swimming Crabs); these are also indicated in Table 2. The total

Table 1: Major crab habitats in Mangrove Bay.

Major Habitat	Minor Habitat	Crab Species
Sand Beach	above slope	*Coanobita spinosa*
	beach slope	*Ocypoda convaxa* *Ocypoda ceratophthalma*
	lower slope	*Uca mjobargi*
Sandy muddy reef platform	mud flats	*Uca dampieri*
	pools and channels	*Scylla sarrata* *Thalamita cranata* *Portunus pelagicus*
Main creek	sandy bank	*Ocypode ceratophthalma* *Uca mjobargi*
	floor	*Scylla sarrata* *Thalamita cranata*
Minor creek	sandy bank	*Uca mjobergi*
	muddy banks	*Uce flammula* *Uca polita*
	under mangroves	*Sesarma* spp.
	floor	*Scylla sarrata* *Thalamita crenata*
Back lagoon	central banks	*Uca alagans* *Uca polita*
	floor	*Scylla sarrata* *Thalmita crenata*
Landward mangrove edge	under mangroves	*Sesarma* spp.

available habitat is subtly divided between these species and there appears to be little or no competition between species.

DISCUSSION

The number of crab species in Mangrove Bay is remarkably high for the west coast of Western Australia. Mangrove areas in Shark Bay for instance have a reduced count of the supratidal and tidal crab species (only one *Sesarma* and two *Uca*). However, both the diversity of the crab fauna and the mangrove flora of Mangrove Bay more closely resemble that of Exmouth Gulf (unpublished results of our Bay of Rest study) and therefore it may be assumed that it has been isolated from a previously more continuous coastal mangrove system around Northwest Cape.

About 6,000 years ago, mangroves further north at the mouth of the Ord River (Cambridge Gulf) and King Sound (Derby) were much more extensive than they are at present (Jennings, 1975; Semeniuk, 1980) and evidence from edible molluscs in native midden deposits suggests that more extensive and more diverse mangroves were also present in the area between North West Cape and Shark Bay at that time (Mr. G. Kendrick pers. comm.). The mangrove system at Mangrove Bay is probably the relic of an embayment that extended 200-300 metres west as far as the edge of the submerged coastal reef (Fig. 1).

The singular feature that makes the mangal and lagoon of Mangrove Bay noteworthy is the fact that it is the only embayment along the Ningaloo to Northwest Cape coast that does not have a near-permanent sand bar across its mouth.

Since this stretch of coast is almost uniform in its tidal characteristics (semidiurnal), coastal geomorphology (sand dunes and coastal limestone) and hinterland structure (Pleistocene coastal limestone plain), it is suggested that there is a concentration in the flow pathway of the lens of brackish water in the porous coastal limestone plain that directs a slight but more or less continuous flow into the mangrove lagoon; this added inflow is apparently sufficient to provide the means of keeping the mouth open since sufficient

Table 2: Environment, food and respiration of crabs in Mangrove Bay.

Crab Species	Tidal Position	Substrate	Food	Respiration	Salinity
Coenobita spinosa	Supratidal	Sand (beach)	Plant, rotting animal	Air	Wide tolerance, fresh to hypersaline
Ocypode convexa					
O. ceratophthalma					
Sesarma 2 spp.		Mud (salt marsh)	Plant		
Uca elegans	Tidal		Blue-green algae, diatoms, bacteria	Amphibious	
U. mjobergi		Muddy sand (beach)			
U. flammula		Sandy mud (banks)			Marine slightly estuarine
U. polita					
U. dampieri					
Scylla serrata			Carnivore		
Thalamita crenata	Subtidal	Muddy sand (lagoon, sea, creeks)		Water	
Portunus pelagicus					

water runs out even at low tide to prevent a sand bar forming.

There is little doubt that management strategies within the Cape Range National Park will need to take account of the groundwater influence on the region not only for the direct support of the unique subterranean freshwater fauna but also for the subsequent flow into the coastal areas when the brackish groundwater maintains a last remaining pocket of a diverse mangrove system and its associated diverse fauna.

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INSECT POLLINATION IN THE CYPERACEAE

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ABSTRACT

One Australian species, *Cyperus pulchellus*, is added to the list of four species from widely separated regions and genera of the Cyperaceae, which appear to have re-adopted insect pollination.

INTRODUCTION

The Sedges (Cyperaceae, 99 genera, ca 4,000 species) and the Grasses (Poaceae, 620 genera, ca 10,000 species) are amongst the largest monocotyledon families (the others are Liliaceae, 250 genera, ca 3,700 species and the Orchidaceae, 735 genera, ca 17,000 species)

Generally members of the Cyperaceae and Poaceae, unlike the chiefly insect pollinated Liliaceae and Orchidaceae, have numerous unattractive flowers arranged in dense inflorescences and are wind pollinated. However, within both the Cyperaceae and Poaceae a number of species in different genera have apparently again adopted insect pollination (this mode of pollination is considered ancestral for all monocotyledons, Stebbins, 1974).

The species of Cyperaceae considered to be insect pollinated are discussed below:

(1) *Dichromena ciliata* (Fig. 1.B)

Dichromena cilata, a perennial sedge native to Tropical and Central America, has been shown to be pollinated by pollen collecting bees and flies by Leppik (1955). The attractive floral parts are the large white bracts subtending the dense terminal inflorescences, no scent or nectar being produced.

(2) *Ficinia radiata* Kunth. (Fig. 1.C)

Ficinia fadiata is a perennial herb native to the Cape Province of South Africa. The inflorescences are subtended by large attractive golden yellow bracts (the flowers are also yellow). Because of its striking appearance the species has been considered as forming a monotypic genus *Sickmannia*, but is currently placed in the large genus *Ficinia* (Dyer, 1976) which is widespread in Africa.

The author has observed this species being visited by pollen collecting syrphid flies on Table Mountain. However, Everard and Morley (1973) state that *Ficinia radiata* "is native to damp plains and mountains of the Capetown and Clanwilliam areas of the South-Western Cape Province, and is noticable for the ornamental bracts with bright glossy yellow bases which surround the inflorescence. Despite this conspicuous coloration which in most plants would serve to attract birds and insects, the small flowers, borne in a cluster at the base of the bracts are wind pollinated." They provide no data to support this statement, and I was unable to locate any information on the pollination of this species in the literature. Obviously further studies are needed on the